DARPA Director Discusses How Strategic Research Thrusts Provide Technological Innovations to Support Soldiers in Iraq

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The Defense Advanced Research Projects Agency (DARPA) is the principal agency within DOD for research and development (R&D) and demonstration of concepts, devices and systems that provide highly advanced military capabilities. DARPA has been providing technological innovations for national security for more than 40 years. The agency was responsible for funding development of many technologies that had a major impact on the world, including computer networking that eventually grew into the Internet, and the Global Positioning System (GPS). One of DARPA's most recent military projects is a 2-way cutting-edge speech translation system to help Soldiers crack language barriers in Iraq called the IraqComm™. The October 2006 issue of *Army AL&T Online* featured a full-length story on the IraqComm. Visit http://204.255.139.236/clients/asc/web/dev/pubs/alt_online/article.cfm?iID=0610&aid=03 to learn more.

U.S. Army SSG Lorenzo Johnson examines his GPS during a route reconnaissance patrol in Iraq. DARPA led the way in developing GPS for use by the military. (U.S. Marine Corps photo by CPL Brian A. Jaques.)

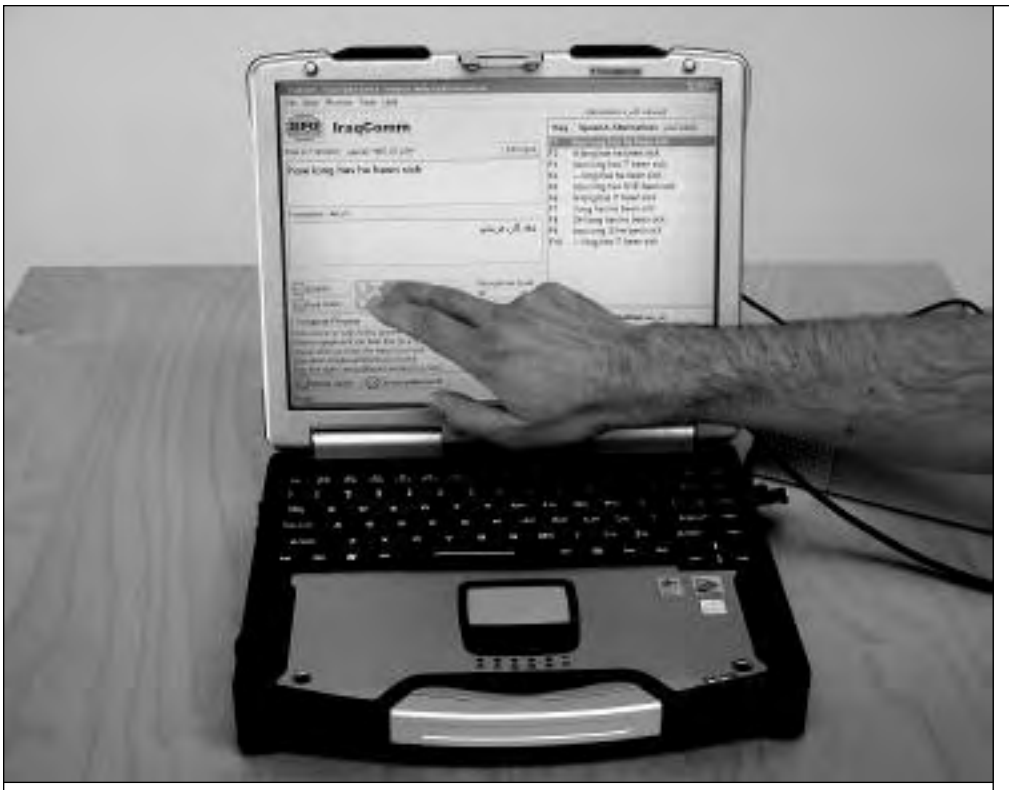
DARPA Director Dr. Anthony J. Tether discusses some of the agency's high-payoff, innovative R&D projects that are helping Soldiers in Iraq now and in the immediate future.

AL&T: DARPA is DOD's only research agency not tied to a specific operational mission and whose only charter is radical innovation. Tell us about DARPA's mission and some of your agency's recent activities.

Tether: DARPA is designed to be the "technological engine" for transformation, supplying advanced capabilities based on revolutionary technological options. DARPA conducts its mission by sponsoring revolutionary, high-payoff research that bridges the gap between fundamental discoveries and their military use. In many cases, our work is opportunity- or capability-driven (to create battlefield surprise) as well as threat-driven (to prevent surprise). DARPA's strategy for accomplishing its mission is embodied in strategic research thrusts. Over time, as national security threats and technical opportunities change, DARPA's strategic thrusts change.

AL&T: Tell us about some of these thrusts — particularly the ones that are impacting the Army right now — and the forces driving them, along with some illustrative examples.

Tether: DOD is in the middle of a transformation toward network-centric operations. Networks are the core of this concept. A major element of network-centric operations is command and control (C2) [or, as the Army now refers to it, battle command]. We developed a distributed C2 system — Command Post of the Future (CPOF) — that allows C2 centers to be wherever



DARPA funded the development of a speech translation device called the IraqComm, which Soldiers are currently field testing in Iraq. (Photo courtesy of SRI International.)

the commanders are, without regard to a fixed geographic location.

CPOF has succeeded beyond all expectations. The Army is using our CPOF technology in Iraq because it offers more flexibility and insight, and allows them to share information and respond more quickly. At least three divisions have successfully fielded CPOF. The 4th Infantry Division (ID) has been using CPOF in combat in Baghdad since its deployment in late 2005. The final transfer of CPOF deployment from DARPA to an Army Program of Record was scheduled for April 2006, but was effectively transitioned to the Army's program executive office two months early. There are additional requests for immediate fielding support from the entire Joint community, each of the other services individually and several interagency groups, as well as requests for high-priority expansion within the Army.

When I was in Iraq a few months ago, I visited many locations and was surprised to find CPOF terminals wherever I went. I asked how they were working and received great compliments on how personnel were now able to coordinate and collaborate at all times of the day. In fact, I heard one story where a major was able to give a briefing while just wearing his underwear to a general officer at another location.

I sometimes would ask if personnel knew where the CPOF terminals had come from and usually received a shrug of the shoulders, commenting that they thought it was the Army. This is the best compliment DARPA can get, when something becomes so embedded that DARPA's identity is lost, as it should be.

DARPA is working with the services toward a vision of filling the operational environment with unmanned systems networked with manned systems. A number of UAS are part of our support to the Army's FCS program, including the MAV.

AL&T: How is DARPA supporting the Future Combat Systems (FCS) effort?

Tether: DARPA is working with the services toward a vision of filling the operational environment with unmanned systems networked with manned systems. A number of unmanned aircraft systems (UAS) are part of our support to the Army's FCS program, including the Micro Air Vehicle (MAV). The MAV Advanced Concept Technology Demonstration program is delivering a low-cost, platoon-level "hover and stare" intelligence, surveillance and reconnaissance system for the dismounted Soldier. This program has successfully completed a month-long field experiment using 10 air vehicles with the 3rd Brigade, 25ID, U.S. Army Pacific. In October 2006, 50 air vehicles with refinements were delivered to 25ID for experimentation. Upon successful completion of that experimentation, those MAV units will remain with 25ID for their continued use. The Army and the FCS Lead Systems Integrator are proceeding with plans to develop the Class I FCS UAS using the MAV ducted fan.

Also, DARPA's FCS Communications (FCS-C) program has developed a mobile, ad hoc network designed to enable ground and airborne on-the-move and stationary network-centric operations. The FCS-C network was recently upgraded with new and modified software, such that FCS-C now operates as a gateway, rather than as a router network. The results were demonstrated interoperability among various current and

future communications radios — via the network, not the radio.

Specifically, interoperable communications were demonstrated by Army Signal School personnel at Fayetteville, NC, and Fort Benning, GA. We showed that it was possible to have previously incompatible tactical radios talk seamlessly among themselves and to more modern systems. We believe that this offers a potentially more affordable route for military communications interoperability in the future. This upgraded FCS-C system has been transitioned to the U.S. Special Operations Command for evaluation and use.

AL&T: Urban area operations (UAOs) are one of the most difficult challenges facing Soldiers in Iraq, and one of DARPA's thrusts is UAOs. What innovative technology has DARPA developed to help Soldiers conduct safer UAOs?

Tether: Our UAO thrust is aimed at creating technology to help make Joint operations in cities as effective as operations in nonurban areas. Let me describe some of the things we are working on in a little more detail.

DARPA's *Advanced Soldier Sensor Information System and Technology* (ASSIST) program focuses on tools to enhance the intelligence-gathering capabilities of our ground troops. We are developing special sensors, networks and databases so that patrol leaders can directly add to, and tap into, the collective experience of previous patrols, including the details of what has been encountered in specific neighborhoods. ASSIST will help intelligence analysts and front-line patrol leaders build and share knowledge of what's going on in various city neighborhoods. ASSIST is beginning to be integrated into training exercises of Army units preparing for redeployment in Iraq.

The *Networked Embedded Systems Technology* program is providing a common software infrastructure for future sensor nets, and we're demonstrating it in some exciting ways. In a test at Fort Benning, we showed that an ad hoc network of simple acoustic sensors could determine the source of a rifle shot to within two meters, within two seconds of the shot. In 2006, we tested a sensor network over a 10-square-kilometer area to simulate detecting people trying to cross a border or facility perimeter.

Our *Combat Zones That See* program is networking conventional video cameras together to monitor vehicle movement. Computers embedded in each camera find and characterize vehicles in view by color, size and number of wheels, and this information — including where each vehicle is parked or moving — is sent to a monitoring site where the data is pieced together. In 2005, we proved that the concept would work, and we have installed it at a base in Iraq so that we can extend perimeter security into surrounding neighborhoods.

A U.S. Army Soldier from 1st Battalion, 3rd Special Forces Group, prepares to launch a Tactical MAV, a UAS with a body length of just 21 inches. DARPA has fielded a smaller MAV to 3rd Brigade, 25ID for testing. (U.S. Army photo by SGT Andre Reynolds.)

A U.S. Army Soldier from 1st Battalion, 187th Infantry Regiment, 101st Airborne Division, assembles a portable radio set during a weapon cache search mission in Iraq. DARPA's FCS-C program recently demonstrated interoperable communications between incompatible tactical radios and more modern systems that are expected to make communications between tactical radios seamless and affordable. (U.S. Army photo by SPC Charles W. Gill.)

Our *Multispectral Adaptive Networked Tactical Imaging System* (MANTIS) program recently developed a new camera that provides unprecedented night vision, even on a moonless night. We are now miniaturizing these cameras and mounting them on Soldiers' helmets. MANTIS will network them together to allow a Soldier to see the same scene as his buddy around a corner, so they can quickly come up with a coordinated plan of action.

Another typical urban mission requires a U.S. team to pursue adversaries inside a multi-story building. Previously, the defenders have had a major advantage in knowing the interior layout. Technology that would allow our team to quickly map the inside of the building would go a long way to improving the team's effectiveness and safety. Recently designed *Radar Scopes* will allow troops conducting UAOs to sense through more than 12 inches of concrete to determine if someone is hiding inside a building or behind a wall. DARPA's Radar Scope does not provide images, but will provide critical situational awareness by enabling troops to determine whether a room is occupied before entering it. The unit weighs less than 1.5 pounds, runs on AA batteries and will cost under $1,000 in production quantities.

When traveling in a convoy, road noise makes it is difficult to know if you are under fire. DARPA's low-cost *Boomerang Shooter Detection and Location System* tells people in a convoy whether they are being fired upon and where the shots are coming from. Boomerang has been improved, based on results from the 50 original units deployed in Iraq, and an additional 66 upgraded units with superior system performance have been deployed to Iraq.

We are also developing novel, high-strength nets to stop mortar rounds and rocket-propelled grenades (RPGs). Counter-mortar nets have successfully caught 60 mm mortar rounds, while counter-RPG nets have proven successful at ranges of at least 50 meters.

Keeping suicide bombers at bay, while maintaining freedom of movement for our warfighters, is a key challenge. DARPA has demonstrated an artificial polymer "snow" that makes the ground very slippery, and that can easily be reversed to restore traction rapidly.

AL&T: How is DARPA using computing technology to help our military maintain technological superiority?

Tether: Computing technology is central to maintaining the U.S. military's technological superiority. One cognitive computing program is called the *Personalized Assistant that Learns* (PAL) program. PAL's goal is to use machine learning technology so information systems can adapt, in real time, to the changing conditions confronting military commanders. PAL systems will

Soldiers from the 1st Brigade Combat Team (BCT), 2nd Battalion, 37th Armored Regiment, 1st Armored Division, climb a stairwell as they clear a house during a patrol in Iraq. DARPA's recently designed Radar Scopes will allow Soldiers conducting UAOs to sense enemy troops or noncombatants through concrete walls. (Photo by SSGT Jacob N. Bailey, U.S. Air Force, 1st Combat Camera Squadron.)

automatically adjust to new environments and new users, helping commanders adapt to evolving situations and priorities and help new CP personnel become effective more quickly.

Learning technology developed under PAL has been applied to raw data taken from CPOF operations in Iraq to learn models of command activities. CPOF messages were analyzed to learn to identify topics of interest, such as checkpoints, routes and mortar attacks, and the networks of individuals who were involved in handling those topics. A PAL algorithm learned to recognize points where a CPOF user changed his focus of attention. A third application of PAL learning technology identified relationships among CPOF objects, such as objectives, activities, units, maps and reports, by examining the particular networks of users who shared them.

AL&T: What is DARPA doing to help Soldiers improve their performance and provide a degree of comfort while performing their mission?

Tether: DARPA's "bio-revolution" thrust seeks to answer the question, "How can we use the burgeoning knowledge from the life sciences to help the warfighter?" The *Peak Soldier Performance* program has developed a completely new approach to maintaining normal body temperature in the face of extreme heat. The *Rapid Thermal Exchange Device* is a special cooling glove into which one hand is inserted. A slight vacuum is applied to the palm, which contains special blood vessels that can act like radiators. Cold water circulates through the grip, and, as a result, large amounts of blood can be rapidly cooled, maintaining normal body temperature even in extreme heat or during exertion.

The device has been so successful in preliminary evaluation by the military that 125 prototype units are now deployed with an Army combat brigade in Iraq. In the next year, we will design and manufacture specially adapted devices for warfighters in vehicles and aircraft, as well as dismounted troops.

AL&T: Thank you for your insightful information.

Tether: I hope my remarks today have given you a sense of DARPA's programs and our ambitions.

A U.S. Army Soldier from Alpha Co., 2nd Battalion, 1st Infantry Regiment, 172nd Stryker BCT, provides security during a search through an area in Baghdad, Iraq. Soldiers in Iraq will benefit from a special cooling glove, called the Rapid Thermal Exchange Device, designed to maintain a Soldier's body temperature in extreme heat or during exertion. (Photo courtesy of PH1 Martin Anton Edgil, U.S. Navy.)

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